Moving toward a universally accessible web: Web accessibility and education

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ABSTRACT
The World Wide Web is an extremely powerful source of information, inspiration, ideas, and opportunities. As such, it has become an integral part of daily life for a great majority of people. Yet, for a significant number of others, the internet offers only limited value due to the existence of barriers which make accessing the Web difficult, if not impossible. This article illustrates some of the reasons that achieving equality of access to the online world of education is so critical, explores the current status of Web accessibility, discusses evaluative tools and methods that can help identify accessibility issues in educational websites, and provides practical recommendations and guidelines for resolving some of the obstacles that currently hinder the achieveability of the goal of universal Web access.

Introduction
It is easy to see why the World Wide Web has become an indispensable part of daily life for many professionals. With an internet connection, one can complete a variety of tasks online in mere minutes that would require significantly more time and effort otherwise. Whether it’s shopping for consumer products and services, managing finances, exploring career opportunities, staying in touch with family and friends, keeping up with news coverage, or simply wasting away a few hours playing games or watching movies, the Web literally puts the world—and all it has to offer—at one’s fingertips. It is little wonder, then, that the Web has become such an attractive and well-utilized tool. And as its popularity has grown, the sheer volume of the content available has exploded exponentially. According to statistics, the number of unique web pages identified by Google’s software engineers in 2008 was in the range of one trillion (Google, 2008). In the relatively short span of eight years, that number has increased to 130 trillion (Google, 2016); a stunning multiplication of 130 times.

While it is true that the Web opens up enormous new avenues of opportunity, knowledge, and possibility for many, in order to be truly democratic, it would also need to be equally accessible to all who want to use it. However, any number of barriers exist that prevent people with disabilities from making full and unfettered use of the Web. These barriers create disadvantages for people with disabilities because they cannot benefit from the services and information available online. Just as importantly, to the extent that the Web facilitates active participation in society, if people with disabilities do not have equal access, they may be excluded from many forms of social participation.

And in fact, the goal of equality of access was an integral part of the vision for the Web from the start. Tim Berners-Lee, the creative mind behind the Web’s invention, imagined the online space as an inclusive community for all, and saw the power of the web as arising from its universality (W3C, 2010). For that reason, he believed an essential aspect of the Web to be “access by everyone regardless of disability” (W3C, 2010).

The issue of ensuring equal access for people with disabilities is no small one, because the number of individuals with disabilities globally could be close to 650 million (WHO, 2010). And that figure is reasonably expected to rise in the future, if statistics from the United States are any indication. In the United States alone, about 54.5 million people had some type of disability in 2005, but that figure had increased to 56.7 million (roughly 19% of the population) within the space of 5 years (Brault, 2012). As early as 2002, it was reported that 12% of those using the Web had disabilities (Lenhart, 2002). However, given that the total number of individuals with disabilities is increasing, in combination with the fact that the number of people using the internet has increased tremendously in the intervening years, it is more than likely that the percentage of users with disabilities at the current time is significantly higher.

Individuals with certain types of disabilities (visual, auditory, mobility, speech, cognitive, and neurological) will often encounter the most difficulties in using the Web. Although there are assistive technologies available, such as text-to-speech software or screen readers, which can enhance accessibility, these technologies can only function properly if the content adheres to principles of accessible design that take into account how the user will access a given page. In other words, the criteria for ensuring equal accessibility for users with disabilities should be that the user is able to navigate and interact with the content as the creator of the web page intended.

Hudson, Weakley and Firminger (2005, para. 3) pointed out that “those with cognitive disabilities and learning difficulties, appear to have slipped through the cracks to a large extent when it comes to website accessibility.” It is important to emphasize that many accessibility standards and research...
studies are focusing on the needs of blind users or people with restricted motor movements (Giannouni, Land, Beyene, & Blanck, 2017; Hoffman, Hartley, & Boone, 2005). This may be because “It is an unfortunate fact that the web accessibility community has struggled for some time to come to a consensus on guidelines that can be applied to web content for individuals with cognitive disabilities.” (WebAim, 2013, para. 1).

Having said that, it is also worthwhile noting that the term ‘accessibility’ is often too narrowly understood as applying only to people with disabilities. But it is best thought of in a broader context that encompasses all users. As Mankoff, Fait, and Tran (2005) noted, “Web accessibility involves making web content available to all individuals, regardless of any disabilities or environmental constraints they experience” (p. 41). Or as Beddow, Kettler, and Elliott (2008) put it, ‘accessibility’ should be defined as “the extent to which an environment, product, or service eliminates barriers and permits equal access to all components and services for all individuals” (p. 1). These understandings of accessibility are, of course, completely consonant with Berners-Lee’s original vision, which included the requirement of universality of access.

With respect to the goal of making web sites accessible to all, regardless of their level of disability or ability, then, one of the main design principles that should be adhered to is flexibility. Web sites should be flexible enough to “meet different user needs, preferences, and situations” (World Wide Web Consortium (W3C), 2009a, para. 4). These needs, preferences, and situations would, of course, include various types of permanent disabilities, but would also allow for including other factors that act as barriers to access, “such as people using a slow Internet connection, people accessing via mobile phones or PDAs, people with temporary disabilities such as a broken arm, and people with changing disabilities due to aging” (W3C, 2009a, para. 4). Or to put it more simply, a well-designed, accessible web site web sites “should provide equal or equivalent access to all users, and it should work compatibly with assistive technologies” (Jaeger, 2006, p. 170).

There is no doubt that the Web is an extremely powerful source of information, inspiration, ideas, and opportunities. And in the sense that anyone with internet access virtually anywhere in the world can take advantage of all it has to offer, it could also be described as a ‘democratic’ tool. At least, that is true in theory. The main purpose of this article is to review the current status of educational Web accessibility.

Web accessibility in education is important because it is one of the most critical issues facing education. It is important that educational Web content be accessible in order to provide equal access to all students including students with disabilities.

This paper illustrates some of the reasons that achieving equality of access to the online world of education is so critical, explores the current status of Web accessibility, discusses evaluative tools and methods that can help identify accessibility issues in educational websites, and provides practical recommendations and guidelines for resolving some of the obstacles that currently hinder the achievability of the goal of universal Web access.

### Web accessibility and education

UNESCO reports that people with disabilities face “a wide range of barriers, including access to information, education, health care and a lack of job opportunities” (UNESCO, 2013 p. 3). For instance, it is not easy for people with disabilities to find employment. In the US, US Census Bureau reports that “about 4-in-10 individuals aged 21 to 64 with a disability were employed, compared with 8-in-10 individuals with no disability” (Brault, 2012 p. 3). Even when employed, people with disabilities make less money than people without disabilities. For instance, U.S., Census Bureau further reports that “adults age 21 to 64 with disabilities had median monthly earnings of $1,961 compared with $2,724 for those with no disability” (U.S. Census Bureau, 2012, para. 15).

In relatively recent years there has been increasing level of understanding about the importance of equal access (Lazar, Beere, Greenidge, & Nagappa, 2003) in general. Likewise, with the explosive growth of the internet there has been, since the mid-1990s, a steadily increasing awareness about issues related specifically to website accessibility (Stewart, Narendra, and Schmetzke, 2005), generating activity from a variety of parties, including community organizations, researchers and government agencies (Kane, Shulman, Shockley, & Ladner, 2007).

Perhaps this growing awareness should be unsurprising, given that the issue of equal access to resources is a critical one with the potential to impact everyone, not just those with disabilities. And nowhere is that more the case than with respect to education. That is because the availability – and quality – of education is a determining factor in shaping the future of not only individuals, but also of society as a whole. Inarguably, success (or lack of it) in the educative sphere very often dictates the career choices, economic success, and lifestyle options open to the individual. But knowledge and learning are also central components in facilitating economic, political, and social progress within a society. In other words, efforts to make education more accessible promise benefits for all.

And in this regard, the internet is playing a very significant role, because of its power to alter the educative landscape, especially in the case of higher education. Traditionally, the educational process took place solely in physical spaces and at designated times, so that every student was effectively tied to a predetermined schedule dictating time and place. However, the internet has made this process much more accommodating and flexible for students at many educational institutions, because they can now gain access to the curriculum when it is convenient for them via the Web. The ability to access educative resources at any time, and from any place, may seem to
be only a small step in the right direction. But, for many students, especially those who may have difficulties attending classes on a regulated, rigid schedule for any number of reasons – from physical disability to distance to work commitments or family responsibilities – it may make all the difference in whether they are able to pursue their educational aspirations or not.

UNESCO (2013) pointed out that the successful application of information and Communication Technologies “can make classrooms more inclusive, physical environments more accessible, teaching and learning content and techniques more in tune with learners’ needs” (p. 3). Making the educative process more flexible and adaptable is only one of the ways in which the internet is making education more accessible. It has also opened up new possibilities for educators, by enabling new and innovative options for educational practices. For instance, web-based instruction, online libraries, and websites with materials and resources for individual classes are rapidly becoming commonplace. In fact, there is an expectation in many countries that teachers will utilize the web to accomplish a broad diversity of goals, from the academic to the administrative (Gibson & Oberg, 2004; Kurt, 2010). According to statistics, this expectation is being fulfilled. In 2002, the Pew Internet Project Survey found that 48% of students at the university level had taken at least one course for which utilizing the Web was required. Furthermore, a survey of 2,462 teachers revealed more than 90% of the teachers stated that “the internet has a major impact” on their ability to access content, resources, and materials for their teaching” (Purcell, Heaps, Buchanan, & Friedrich, 2013, p.1). Likewise, in the USA, 5,8 million students took one or more online class in 2015 (Allen & Seaman, 2016). In the intervening years, with the explosion in the number of internet users, it is not unreasonable to assume that the percentage is even higher. Students with disabilities meet challenges in online courses. Educational institutions are obligated to make content in online classes accessible to all students. However, the majority of students with disabilities do not disclose that they have a disability even they are presented course materials in an inaccessible format. (Roberts, Crittenden, & Crittenden, 2011).

All of which makes the necessity of ensuring that Web-based educational materials are wholly accessible, regardless of the circumstances of individual users, even more important. Unless all people, regardless of age, level of experience, disability, and the technology and systems being used, are able to gain the full benefit from their browsing experience, the goal of equal access and opportunity will not be met.

Part of the uniqueness of the Web is that it offers the potential for overcoming many of the barriers that some users may encounter with more traditional educative tools. However, these barriers can only be avoided if web environments are designed not only for convenience, but also for accessibility by users with diverse needs, in mind (Kurt, 2017). In broad terms, the goal of ensuring accessibility can be interpreted to mean that users are not confronted with any obstacles that would prevent them from using the technology, engaging with the Web content, or get the full benefit of experiencing the resource in the way the designer intended. More narrowly, with respect to e-learning, accessibility should be understood to apply to the learning environment as a whole. This means that elements that make up the learning environment, such as virtual classrooms, digital repositories, wikis, blogs, multimedia resources (videos, Word files or PDF files), web portals, and discussion forums should be adaptable to meet the needs of individual learners, regardless of disability.

Making Web accessibility a central focus is not simply a suggestion, or even solely an ethical goal. In fact, it is a legal requirement for websites in many parts of the world, including the United States (Section 508, Rehabilitation Act), Australia (Disability Discrimination Act, 1992), the United Kingdom (Disability Discrimination Act, 1995), and Ireland (Disability Act, 2005). More to the point, these anti-discrimination legislations place educators and educational institutions under a legal obligation to make certain that the e-learning technologies and content that they use are fully accessible. While this legislation goes a long way toward making educators aware of the importance of equality of access, it is of somewhat limited value in giving educators the tools for fulfilling their responsibility in this regard. As Seale (2006) noted, very few know exactly how to achieve the goal of accessible e-learning, a fact that she finds somewhat surprising, in light of the substantial number of tools available specifically for this purpose (Seale, 2006).

The Americans with Disabilities Act of 1990 prohibits discrimination based on disability. This legislation is the most comprehensive law protecting the rights of people with disabilities in the US. (Golden, Kilb, & Mayerson, 1991). It is the first major piece of US legislation to enforce information accessibility. These laws force educational institutions to create more accessible web content. In fact, several universities in the U.S. had to resolve a civil rights complaint about the inaccessibility of its web content (for a list of complaints, please visit http://www.d.umn.edu/~lcarlson/attorneys/lawsuits.html), as they face liability for inaccessible information technology under these legislations and laws.

Educational web accessibility at present

Despite the fact that anti-discrimination legislation places the onus of responsibility for ensuring accessibility on educators and educational institutions, a number of research studies indicate that many existing websites remain inaccessible (Espadinha, Pereira, Da Silva, and Lopes, 2011; Hackett, Parmanto, & Zeng, 2005; Kamoun & Basel Almourad, 2014; Lazar et al., 2003; Lazar & Greendige, 2006; Thompson, Comden, Ferguson, Burgstahler, & Moore, 2013). The majority of these studies, which focused mainly on university and library websites, confirm the existence of a variety of accessibility problems (Alexander and Rippon, 2007; Green & Huprich, 2009; Harper & Dewaters, 2008; Kurt, 2011, 2017; Lazar et al., 2003). Internationally, many of the most highly rated universities presented accessibility issues, particularly those in non-English speaking countries. In other words, despite the fact that the overall trend toward improving accessibility is a positive one, many websites associated with
The value of e-learning, especially for students with disabilities, is uncontestable. For one thing, e-learning approaches allow users to overcome barriers linked with physical distance and rigid, inflexible learning activities. For instance, in countries where living conditions are not ideal, inaccessible buildings or unreliable public transportation may make it almost impossible for a person with a physical disability to attend classes regularly. Likewise, the availability of e-learning options makes it possible to circumvent certain barriers that students with disabilities would otherwise encounter in attempting to access course materials and resources. Someone with a physical disability that impairs mobility, for instance, will find it much easier to obtain a transcript by ordering it from home through a university website, rather than being required to travel to the university to obtain the document from the administrative office. Although these are only two examples, barriers can include any number of factors, including the manner in which users interact with learning materials, the interface elements of the system within which these materials are located, the way content is uploaded, and the type of technology being used.

Learning Content Management Systems

A case in point is that of Learning Content Management Systems (LCMSs). The most well-known LCMSs are Desire2Learn, Moodle, Canvas, and Blackboard, which are all commonly used to deliver online courses, as well as blended courses or flipped courses. Typically, the content of an LCMS environment will contain a diverse array of resources and materials, such as forum postings, tests, timed quizzes, embedded videos, and downloadable documents in various formats. And just as typically, these various components do not exhibit a shared consistency with respect to interface logic or interactive elements. The ability to achieve consistency of access across these various resources and materials, however, is achieved by building flexibility into the LCMS platform itself. Since most of the LCMSs mentioned here were developed according to the standards set by internationally accepted Web Content Accessibility (WCAG) Guidelines 2.0 Level AA, as well as those delineated in Section 508 (United States), they generally provide a good level of flexibility with respect to the individual preferences, needs, and situations of different users.

This flexibility allows for any number of adaptations that enhance the overall accessibility of the content so that it meets the particular needs of users, such as lecture videos with subtitles, which not only benefit users with visual impairments but also international students with poor English skills. Other examples of common adaptive measures include pages that feature large font on uncluttered, plain backgrounds for users with visual impairments, images with ALT text, and documents with titles, subtitles, and heading in an appropriate format so that they can be detected by screen readers. There are, of course, many other adaptive measures that can be incorporated into e-learning environments, but the important point here is that LCMSs allow for a broad spectrum of accessibility options.

But while it is clear that the flexibility of LCMSs improves the level of accessibility for many users with disabilities, this...
does not mean that these tools entirely succeed in achieving the goal of accessibility for all users. This is because LCMSs are designed with the expectation that they will be used with a particular technology or configuration. However, in the event that a different technology is being utilized by either an instructor or a student, accessibility problems can ensue. For instance, if the content that an instructor uploads is not consistent with the requirements of the specific technologies that the LCMS was designed for, or if the instructor is using a different technology, accessibility may be compromised. Just as importantly, for individuals who require nonstandard computer equipment, such as assistive devices, the ability to access the resources and materials provided by instructors may be significantly impaired.

While it is true that a significant body of literature exists with respect to the requirement of enhancing the accessibility of e-learning tools, most of this has focused on doing so from the perspective of students. Scant attention has been paid, however, to doing so from the perspective of the users who create instructional content and curriculum, and what barriers exist for them in attempting to interact with LCMS systems. For example, teachers who use assistive technologies may be hindered in their ability to interact with students if the LCMS platform available to them is not compatible with the particular technology they require.

To be fully accessible, an e-learning environment should take into account the very high probability that at least some users will require non-standard equipment and technology. That may mean that designers will need to address a number of questions, such as whether the management interfaces of the LCMS comply with accessibility guidelines, how to ensure that these guidelines are met with respect to all users rather than only the consumer of the content, and how to make the system flexible enough to be compatible with assistive devices and alternative technologies and equipment. In other words, a great deal more attention should be paid to the needs of all users who play a role within the e-learning environment, whether as instructor or student. One way of accomplishing this would be to take into account the needs and preferences of individual users by means of profiling. A user profile should include a number of factors, including the individual’s learning or teaching goals, the locations where learning will occur, and the particular devices and technology that will be used. This would facilitate a greater degree of user-specific adaptability, which in turn would enhance the level of accessibility the user experiences.

**Massive open online courses**

The most common implementation of LCMSs is in institutions whose main purpose is education, such as schools and universities. However, the emergence of Massive Open Online Courses (MOOCs) has made e-learning systems and content available in the larger public domain. One of the central goals of MOOC systems is to synthesize content and learning resources contributed by community members with LCMS environments. In that sense, MOOCs deliver free access to courseware, content, and assessment models that are similar to those students would typically encounter in universities and colleges, without the financial burden that pursuit of a full degree level course would entail. Providers of MOOCs are often conglomerates comprised of various organizations, each of which contributes discrete materials and resources for the purposes of developing a complete course. Educational institutions also utilize MOOCs as a way to share parts of particular courses with the web community. In some cases, teaching institutions also allow users who have completed the requirements of a course via MOOC to receive credit toward a degree, or to fulfill the entry criteria necessary for admission to further study.

Although the aim is to make educational resources available to the community at large through open sourcing, most MOOCs reside in traditional LCMS environments. This fact is significant, because while the emphasis is on peer-to-peer assessment rather than instructor-led evaluation, most of the assessment tools themselves adhere to the norms for LCMS systems. This raises a number of issues and questions with respect to accessibility. For one, where accessibility standards are specified by a particular organization, once course materials and content are deployed to users, it may be very difficult to ensure that these standards are applied. If the organization hosting MOOC sets a minimum accessibility level, is the host then required to take on the responsibility of auditing contributed content to ensure it is in compliance? In the event that a member of the community encounters accessibility problems with respect to the MOOC platform of its contents, from whom do they seek resolution of these issues? And if it is not resolved, do they have any recourse against the host or content contributors? Furthermore, do MOOC hosts have a responsibility similar to that of institutes of higher learning to make their accessibility standards known to users (via publication of their websites, for instance), and if so, in what manner?

It is clear that MOOC platforms do increase accessibility in general, because of their ability to deliver educational resources and opportunities to members of the community at large, including those outside academic for whom these resources may otherwise be unobtainable. In that sense, MOOCs help to further the democratic potential embedded in the Web. Furthermore, because they are usually housed in LCMS, MOOC platforms can take advantage of the features already built into LCMSs that help overcome accessibility barriers for many users. But, it is also clear that the MOOC concept raises almost as many questions as it answers, especially with respect to how to maintain compliance accessibility standards on an ongoing basis, and who has the responsibility for doing so.

**Achieving web accessibility**

Full and comprehensive web accessibility depends not only on the inclusion of a number of critical components, but also on achieving a synthesis amongst them so that they effectively and in concert. The components identified by W3C (2016) as necessary are:

1. Natural information (text, images, sound)
2. Web browsers, media players, and similar content agents
3. Assistive technologies
Achieving functional Web accessibility evaluation tools

(4) Knowledge and experience of Web users

(5) Developers, web designers

(6) Authoring tools for website creation (i.e., DreamWeaver, FrontPage)

(7) Automatic Web accessibility evaluation tools

It is not necessary for stakeholders to start from scratch in attempting to formulate policies related to online content. Consulting already existing guidelines for web accessibility could prove invaluable. The most well-established of these are from the World Wide Web Consortium (W3C), which is an organization focused on regulating and developing web technologies. Two versions of their Web Content Accessibility Guidelines (WCAG) have been published: WCAG 1.0 in 1999; WCAG 2.0 in 2008. The later version, which is more up to date, is recommended.

While the WCAG guidelines are very detailed and include many very technical terms, a summary is also available which is very clear and easy to understand. The summary, which is available through the W3C website (W3C, 2009b), includes guidelines broken down into four function-specific categories, as follows:

**Perceivable**

(1) Provide text alternatives for non-text content.

(2) Provide captions and alternatives for audio and video content.

(3) Make content adaptable; and make it available to assistive technologies.

(4) Use sufficient contrast to make things easy to see and hear.

**Operable**

(1) Make all functionality keyboard accessible.

(2) Give users enough time to read and use content.

(3) Do not use content that causes seizures.

(4) Help users navigate and find content.

**Understandable**

(1) Make text readable and understandable.

(2) Make content appear and operate in predictable ways.

(3) Help users avoid and correct mistakes.

**Robust**

(1) Maximize compatibility with current and future technologies.

According to the W3C, following these WCAG guidelines “will make content accessible to a wider range of people with disabilities, including blindness and low vision, deafness and hearing loss, learning disabilities, cognitive limitations, limited movement, speech disabilities, photosensitivity and combinations of these” (W3C, 2008b, Para. 1). And many countries (including Spain, Turkey, Japan) have in fact successfully adopted them (Kurt, 2017).

While the WCAG guidelines themselves are both comprehensive and easily implemented, the task of analyzing and verifying the accessibility of a given site can be quite time-consuming. In an effort to expedite the process, developers have produced automated tools that have the capacity to scan and evaluate web pages for accessibility compliance. A
number of evaluation tools are available on WCAG websites (W3C, 2014). But while these tools can be extremely useful, they may fail to identify all potential issues, which means that the website creator is often required to make use of a manual evaluation or checklist (Parmanto, and Zeng, 2005) as well.

There are also tools available that go beyond identifying compliance issues, because they have the additional capacity to help website creators achieve accessibility goals. They do this by essentially crawling websites, evaluating the content to determine whether it matches accessibility criteria, and then displaying the results in a user-friendly manner. Where non-compliant content is identified, the tool directs users to documentation containing the details of the appropriate repair steps. While such tools can prove indispensable to website creators because they can “help determine if a Website meets accessibility guidelines” (W3C, 2006, para 1), they do not represent total, hands-free solutions. This is because “some of the web-content accessibility checkpoints cannot be checked successfully by software algorithms alone. There will still be a dependence on the user’s ability to exercise human judgment to determine conformance to the guidelines” (W3C, 2000, Introduction section, para 4). In other words, these tools do not have the capacity to replace the human mind in the evaluative process. For example, even though an automated tool can determine whether an image is accompanied by ALT text, it does not have the discernment to decide whether existing ALT text is used correctly or in a useful way.

The most well-known evaluative tool by far was the now-defunct Bobby. Developed by the Center for Applied Special Technology (CAST), Bobby was used in numerous studies focused on web accessibility (e.g., Harper & Dewateres, 2008; O’Grady, 2005; Potter, 2002; Shi, 2007). In 2004 Bobby was purchased by the company Watchfire, which was subsequently acquired by IBM in 2007, and at a later date the decision was made to discontinue Bobby. However, an abundance of evaluative tools are presently available. As of mid-2017, at least 93 are listed (but not necessarily endorsed) by W3C (w3.org/WAI/ER/tools/complete). The features and characteristics of these tools vary, for instance by language (English, German, etc.), license type (open source, commercial etc.), guideline version used (WCAG 1.0 or WCAG 2.0), and operating systems (Windows, Linux etc.). Amongst the tools available, some of the more noteworthy are:

1. Functional Accessibility Evaluator: a web based tool Developed by the University of Illinois; available at http://fae.cita.uiuc.edu/
2. WAVE: Developed by WebAIM, which is an initiative of Utah State University, WAVE is also a web based tool; available at http://wave.webaim.org/
3. HERA: developed by Carlos Benavidez, HERA is another web based tool; available at http://www.sidar.org/hera/index.php.en
4. Firefox Accessibility Extension: a Firefox web browser extension created by the Illinois Center for Information Technology and Web Accessibility (iCITA); available at http://firefox.cita.uiuc.edu/

The author of this paper evaluated accessibility of Turkish university websites in 2011 and 2017. The results of these evaluations were published (see Kurt, 2011, 2017). The author used AChecker, which proved to provide the most accurate results during the author’s previous studies. AChecker was developed by ATRC at the University of Toronto and is available at: atutor.ca/achecker. As stated above, W3C website list many tools. Furthermore, the W3C website also includes filters to help find the best tools for particular needs.

As explained above, while these tools are useful in determining accessibility, they are somewhat limited due to the fact that they are insufficient, in and of themselves, of completely evaluating website accessibility. Human involvement and judgment are still required. In order to mediate the potential for certain evaluative tools to miss – or misidentify – accessibility issues, triangulation is recommended. Cross-verification from more than two sources will deliver a more thorough validation of data.

### Practical accessibility recommendations

Studies have shown that despite the widespread nature of accessibility issues within websites, most of these are minor and easily resolved. One study, for example, evaluated the homepages of 50 websites, including those of 6 universities, and concluded that “while the majority of Websites are inaccessible, at the same time many of these web sites require only a small amount of work to become fully accessible” (Lazar et al., 2003, p. 339). For that reason, it is worthwhile to devote some attention to practical and easily implemented suggestions that instructors can apply to repair relatively small issues.

One of the most common errors identified by researchers, including O’Grady (2005) and Friedman and Bryen (2007), is missing or incorrectly used text descriptions (ALT text) for images in HyperText Markup Language (HTML). Although these errors are relatively minor, missing or incorrect ALT text can significantly impair accessibility because screen readers and Braille embossers can only read text. The graphic below demonstrates an example of the minor differences between incorrect and correct usage of web tags for ALT text.

Another minor but typical error involves resizing capacities. Ideally, users of Web browsers such as Internet Explorer or Mozilla Firefox should be able to resize web text according to their preferences and needs. If a website is designed poorly, so that the capacity to do so is absent, users with vision problems may encounter difficulties in accessing the content. Stylize font sizes and absolute units (in, cm, mm, pt, pc) should not be used. For instance, styling fonts like this `<font size = “1”> Main Page </font>` or Font-Size: 9Pt is not accessible. Instead percentages (%) and `em` elements should be used such as font-size: 2em. W3C also recommends the use of `em` elements (W3C, n.d.).

In addition, the inclusion of blinking, rolling or scrolling content may result in impaired accessibility for users. A too-rapid scroll may not give users sufficient time to read the
content (which violates the W3C guideline ensuring that users are given adequate time to read and interact with the content). This is especially true for users who require a screen mag- nifier, because they may not be able to keep up with scrolling content. Another reason to avoid rapidly blinking or flashing content is that it may may elicit seizures in users with photosensitive epilepsy.

Link text such as click here or read more is intended to help users navigate websites and pages more easily and directly. But for visually impaired users, who use screen reader software or browse web pages by tabbing from one link to the next using the keyboard, the invitation to click here may be less than useful due to the fact that the link texts are inaccessible via the devices being used. For example, if you are pointing your students to a page called “Assignments”, the followings are correct and incorrect uses:

(1) Incorrect: “Click here to read about the assignments.”
(2) Correct: “To learn more about the assignments, go to the Assignments page.”

Validity evaluation is one of the major criteria for creating a quality website (W3C, n.d.), which is what also makes it a crucial step in producing a website that fulfills accessibility goals (W3C, 2005h). This is because features that are usually neglected in accessibility evaluations are analyzed in the validity evaluation process. These can include analysis of whether the language in which web pages are written, such as Hypertext Mark-up Language (HTML) and Extensible Hypertext Mark-up Language (X)HTML, are used correctly, and can also extend to other elements such as cascading style sheets (CSS) which are used to style web pages by controlling design components like colors or fonts.

In addition, the validity of the coding used for a web page can impact on the accessibility of web browsers such as Explorer and Firefox. These browsers interpret (X)HTML and CSS code and translate it into screen-appropriate displays, but if these codes are incorrect, the interpretation—and ultimately, the display—will most likely be different depending on the type of browser being used, and even on various version of a particular browser. Many websites attempt to address this issue by designating a recommended browser (i.e., “Best viewed with Explorer 8.0+”). Statements like this may be helpful to some users, especially those who have a choice about which browser to utilize, but they are of very little value for individuals who must use alternate browsers. But, simply acknowledging the possibility that an accessibility issue may persist for some users is not the same thing as resolving it. To ensure full accessibility regardless of browser type, validity evaluation should include analysis of whether web pages are coded in compliance with (X)HTML and CSS standards, which can easily be checked with two online tools: for (X)HTML (https://validator.w3.org); for CSS (https://jigsaw.w3.org/css-validator/).

One positive development which has the potential to increase accessibility is a growing preference for simplicity of design, which represents a move toward decluttering and refining spaces. With respect to web design, this trend is reflected in the increasing tendency to remove all unnecessary elements on web pages, which has the result of enhancing the clarity and visibility of the information presented. This benefits all users because with fewer elements, websites are not only easier to navigate, but also load more quickly. And for users with cognitive disabilities, simplified web pages provide even greater benefits, for as Hanson (2001) notes, sites that are visually cluttered and contain irrelevant information can create difficulties in accessing the information they are seeking. To overcome potential barriers for these users (and improve the web experience for all users), the slogan “Keep It Simple” is a good one for designers to embrace. It is important to point out that making an educational website simple (by removing all unnecessary elements) will make the content more accessible for people with cognitive disabilities.

Presenting educational content in alternative formats (visual, oral, and textual) can improve accessibility, because doing so gives learners the freedom to choose the format that is most accessible for them. For example, in an online course, a text version that accompanies the video version of a lecture provides learners with another option to access content. This will help students with sensory disabilities (e.g., blindness or deafness) or cognitive disabilities (e.g., dyslexia).

Another valuable approach to evaluating accessibility is to use a combination of different methods. These could include:

a. Attempting to navigate the page using screen reader software to check that everything is clearly understandable.
b. Visiting the site using a text-only browser to ensure that all the page content is both available and decipherable as it would be with a graphical browser (Lynx is a good option to use for this test; the fact that it is a text-only browser makes it is suitable as a means of verbalizing content via screen reading software).
c. Try to navigate the site via keyboard only (without the use of a mouse); websites that prove un navigable will likely be difficult (or impossible) for individuals with disabilities that require keyboard only or voice-only access.
d. Make use of automated software (as described earlier).
e. Request that colleagues or friends test the website to see how easy it is to use.
f. Consult Web resources and articles dealing with accessibility issues, as many times they contain usable solutions and suggestions.

Using a multiplicity of methods such as those listed is highly recommended, because issues that might become immediately apparent with one method may not be evident at all with another.

Another factor that is sometimes overlooked when accessibility evaluation is attempted is the prevalence of mobile internet use. The rate at which users are accessing the internet through mobile devices has virtually exploded within the last 4 years. In fact, mobile internet is now the most utilized digital platform, far outstripping the desktop (Comscore, 2015). This represents a relatively new challenge for the goal of full accessibility, in that websites should be equally accessible on mobile devices as they are on other platforms. There are a number of tools which can be
deployed to analyze and rate the level of mobile-friendliness for a
specified URL on university websites. One example is a tool
developed by Google, which is available at https://www.google.
.com/webmasters/tools/mobile-friendly/.

Conclusion
Web accessibility is a very broad concept that encompasses a
number of aspects (legal, ethical, technical, and social). Ensuring
Web accessibility requires the removal of barriers and obstacles
so that all individuals are equally able to participate in the online
space. Equality of access means, then, that everyone who desires
to take advantage of all that the internet has to offer can do so,
regardless of their particular circumstances, needs, and prefer-
ences (level of ability/disability, age, education level, equipment
being utilized, and preferred platform, whether that be desktop,
mobile phone, or tablet). Equality of access is particularly critical
with respect to education, because having the ability to use the
Web is quickly becoming a non-negotiable requirement, and a
fundamental part of the educational experience. If the promise of
universality of access so integral to Berners-Lee’s vision is not
fulfilled, untold numbers of individuals may be deprived of the
opportunity to pursue their educational goals and career aspira-
tions. And society as a whole will be all the poorer for that.

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